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Mitigation Action Plan for the Spallation Neutron Source

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SNS
SPALLATION NEUTRON SOURCE

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MITIGATION ACTION PLAN

1.0 Introduction

The Department of Energy (DOE) has prepared and issued a Final Environmental Impact Statement (FEIS) (SNS FEIS, DOE/EIS-0247, April 23, 1999) and a Record of Decision (ROD) to construct and operate the Spallation Neutron Source (SNS). DOE has decided to proceed with construction and operation of the state-of-the-art, short-pulsed SNS facility on the preferred Chestnut Ridge site at the Oak Ridge National Laboratory (ORNL), Oak Ridge, Tennessee. This Mitigation Action Plan establishes the goals, objectives, and procedures by which DOE will mitigate the potential effects, as described in the FEIS, from construction and operation of the SNS at ORNL.

1.1 Purpose of the Mitigation Action Plan

The DOE policy concerning preparation of the Mitigation Action Plan is included in 10 CFR 1021.331(a) of the DOE regulations implementing NEPA:

- Following completion of each Environmental Impact Statement (EIS) and its associated ROD, DOE shall prepare a Mitigation Action Plan that addresses mitigation commitments expressed in the ROD. The Mitigation Action Plan shall explain how the corresponding mitigation measures, designed to mitigate adverse environmental effects associated with the course of action directed by the ROD, will be planned and implemented. The Mitigation Action Plan shall be prepared before DOE takes any action directed by the ROD that is the subject of a mitigation commitment.

- Each Mitigation Action Plan shall be as complete as possible, commensurate with the information available regarding the course of action ... directed by the ROD ... DOE may revise the plan as more specific and detailed information becomes available.

- DOE shall make copies of the Mitigation Action Plans available for inspection in the appropriate DOE public reading room(s) or other appropriate location(s) for a reasonable time. Copies of the Mitigation Action Plans shall also be available upon written request.

The Mitigation Action Plan is an internal DOE management document having three major purposes:

- Specify the environmental effects requiring mitigation, as indicated in the FEIS and the ROD.

- Identify responsibility for the mitigation actions.

- Ensure implementation of the required actions by the responsible parties.

If new information or conditions warrant, revisions to the Mitigation Action Plan will be issued and made available to the public.

DOE has overall responsibility to ensure that the environmental effects described in the FEIS are mitigated, and DOE will meet this responsibility by ensuring the appropriate parties involved in construction and operation of the SNS adhere to the requirements set forth in this Mitigation Action Plan. Implementation will be carried out by the Management and Operations Contractor for ORNL, currently Lockheed Martin Energy Research, and by the Architect-Engineer/Construction Manager (AE/CM) subcontract team of Lester B. Knight and Sverdrup. This AE/CM team is responsible for design and construction of all the buildings, roads, utilities and support systems (otherwise known as the "conventional facilities") required for the SNS.

DOE–Oak Ridge Operations—Overall responsibility for the SNS project. Provides oversight to project contractors.

Management and Operations Contractor for ORNL—Prime contractor for construction and operation of the SNS.

Lester B. Knight, Inc.—The Architect-Engineer entity contracted for design of conventional facilities.

Sverdrup, Inc.—The construction contractor for the SNS.

There are four primary areas of responsibility for assuring the appropriate mitigation of the potential effects discussed in the FEIS. These are defined below:

Mitigation Development—The design of the mitigation action, including the what, how, when, and where of the mitigation action to be taken. The design of the mitigation action will be furnished to the architect-engineer for incorporation into the design of the SNS. DOE's review of the design will ensure that the mitigation measures have been adequately included in the design.

Mitigation Implementation—The implementation of the mitigation action. Companies contracted by DOE may be responsible for implementing mitigation actions associated with the specific facilities being constructed.

Mitigation Monitoring and Reporting—Monitoring the progress of a mitigation action to determine if it is being implemented as designed and if it is having the intended effect (i.e., if the potential effect has been mitigated). This includes determining if the mitigation action is performing as designed and, if not, help in identifying what alternative actions may be necessary to correct the situation.

Mitigation Verification and Performance Confirmation—All aspects of each mitigation action will be evaluated by DOE to determine the state of compliance with commitments made in the FEIS and ROD.

1.2 Organization and Content

This Mitigation Action Plan is organized into five sequential sections. Section 1.0 identifies the specific FEIS to which this plan is linked and briefly states the DOE decision to construct and operate the SNS on the Chestnut Ridge site at ORNL. In addition, it describes the purpose of the Mitigation Action Plan, areas of responsibility for assuring the mitigation of effects identified in the FEIS, and the organizations that will shoulder these responsibilities. Section 2.0 provides a brief overview of the actions that DOE will take to construct and operate the SNS on the selected site. The actions that DOE will take to monitor the effectiveness of implemented mitigation measures are contained in Section 3.0. Section 4.0 begins by describing the changes in SNS design that DOE will make to avoid or minimize potential environmental effects on water resources and terrestrial wildlife. These descriptions are followed by a discussion of the actions DOE will take to mitigate unavoidable adverse effects on the environment. These mitigation actions are presented in subsections according to four aspects of the affected environment (wetlands, protected species, transportation infrastructure, and research projects in the Walker Branch Watershed). In each subsection, the potential environmental effects of the ROD action are summarized, and the reader is referred to the applicable sections of the FEIS for more details. The effect summaries are followed by descriptions of known measures that DOE could implement to mitigate these effects. These descriptions are followed by the specific actions that DOE will take to achieve mitigation using these measures and any other measures that may be selected for implementation during the mitigation process. These actions are presented in a tabular format. In the tables, each action is accompanied by a designated party responsible for the action and the date on which the action will be completed.

The potential environmental effects stated in the FEIS were based on modeling and environmental analyses. However, *in situ* monitoring is necessary to ascertain the extent and degree of the actual environmental effects requiring mitigation, as well as to establish the efficacy of the mitigation techniques themselves. Accordingly, the monitoring efforts that are part of the mitigation plan are designed to answer the following questions:

- Is the project causing environmental effects that were not projected in the FEIS? If so, a mitigation action will be developed for each additional effect.
- Is the mitigation action identified in the Mitigation Action Plan the most appropriate for the potential effect? If not, a revised technique will be developed.
- Have implemented mitigation actions produced the intended results? If not, a different action must be incorporated.

This Mitigation Action Plan presents alternative actions for each of the potential effects that DOE has committed to mitigate. Baseline data collection is necessary for the selection of the most appropriate mitigation action for some of the potential effects. Follow-up monitoring will also be necessary to fulfill the goals of the mitigation actions. After the details of specific mitigation actions are developed, the Mitigation Action Plan will be revised to reflect the various administrative, implementation, reporting, and verification steps.

This Mitigation Action Plan does not include mitigation actions potentially required by permitting activities for the SNS. For example, in the process of obtaining the air permit and the National Pollutant Discharge Elimination System (NPDES) permit, the State of Tennessee may require mitigation actions to reduce adverse environmental effects. These mitigation actions will be negotiated as part of the permitting activities. There will be chemical additives (biocides and antiscaling agents) in the cooling tower blowdown. The chemicals to be used are not known at this time; however, the levels of the chemicals allowed in the effluent will be protective of White Oak Creek and will be negotiated with the Tennessee Department of Environment and Conservation.

2.0 SPALLATION NEUTRON SOURCE OVERVIEW

The purpose of the SNS facility is to provide the United States with a world-class, short-pulsed neutron source to support scientific and industrial research using neutron scattering in areas such as materials science, condensed matter physics, molecular structures of biological materials, polymer and complex fluid structures, and magnetism. This next-generation neutron source creates new scientific and engineering opportunities and it helps replace declining neutron science capacity in the United States as older existing facilities reach the end of their useful operating lives in the first half of the next century.

The SNS will occupy a hammer-shaped area consisting of approximately 110 acres (45 ha) of land. The maximum length and width of the site will be approximately 4,000 ft (1,219 m) and 1,100 ft (335 m), respectively. At the initial operating power of 1 MW, there would be 15 permanent buildings covering about 6 acres (2.4 ha) of land. These buildings will have interior areas totaling approximately 365,000 ft^2 (33,903 m^2). The front end and linac tunnel, along with the parallel Klystron building, would have a total length and width of approximately 2,000 ft (610 m) and 120 ft (37 m), respectively. The initial proton accumulator ring would be about the size of two football fields laid side-to-side, and the target building would measure approximately 280 ft (85 m) by 200 ft (61 m). If upgraded to an operating power of 4 MW, a second proton accumulator ring and target building with the same dimensions as the first would be added to the facility.

Approximately 50,000 yd^3 (38,228 m^3) of concrete and 4,000 tons of steel will be used for construction of the 1 MW SNS. A peak construction workforce of nearly 580 workers will be required during construction of the 1 MW facility, and there will be approximately 1,500 new direct, indirect, and induced jobs. By the end of construction, 4 miles (6.4 km) of permanent, paved roads and parking areas for 250 persons will be constructed.

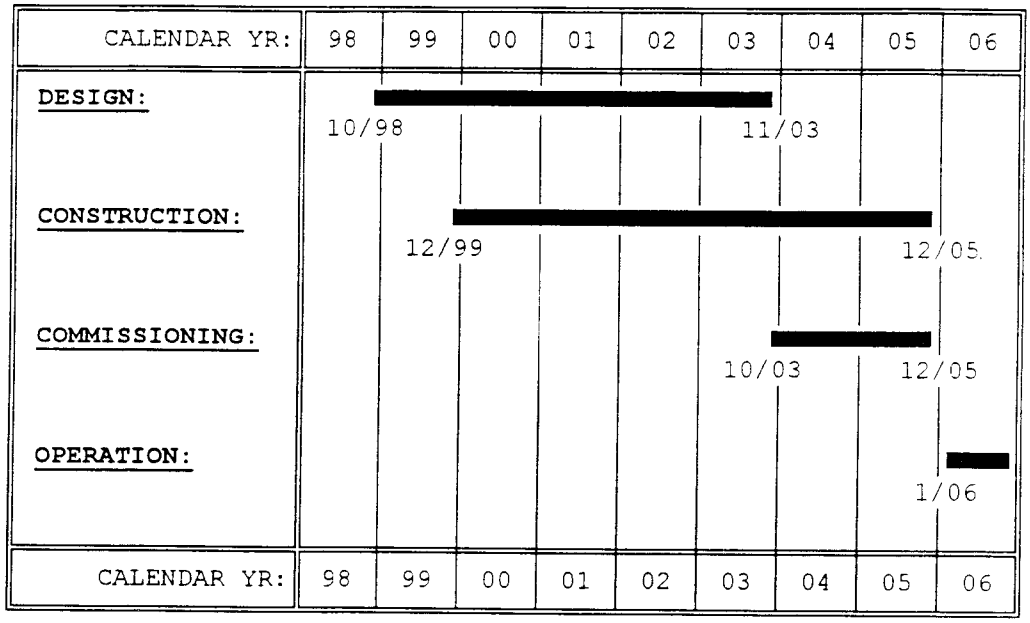
Fully operational, the SNS will use approximately 1,000 lbs/hr of natural gas for heating, 800 (1MW) - 1,600 (4 MW) gpm of water, and 62 MW (1 MW) - 90 MW (4 MW) of electrical power to operate. Approximately 800 gpm of water will be used for cooling the SNS during operation. The heat will be dissipated to the environment with cooling towers and a retention basin prior to release of the water to White Oak Creek. At 1 MW, the SNS will support approximately 180 resident employees (scientists and support personnel) and 70 visiting scientists. Approximately 125 additional people will be added to the workforce when expanded to 4MW.

Radioactivity would not be discharged from the proposed SNS to surface water under normal conditions of operation. Liquid low-level waste and process waste would be collected and transported by tanker truck to existing waste processing facilities. Radioactive emissions to the atmosphere from the proposed SNS would consist of releases from two stacks: the Tunnel Confinement Exhaust Stack and the Target Building Exhaust Stack.

The facility will be designed for upgrade from 1 MW to 4 MW of proton beam power onto the target. This will result in a linear scaling of off-gases from the cooling system and the target. Off-gases from the beam stops and exhausts from the various tunnels through the Tunnel Confinement Exhaust will not increase linearly because their utilization does not increase linearly with increased beam power on target.

The implementation of these upgrades would depend largely on the availability of funding and is not scheduled at this time. For the sake of completeness, however, the FEIS analyzed the effects from the SNS facility as it would be originally built at 1 MW, as well as those corresponding to its fully upgraded configuration of 4 MW. DOE will review the adequacy of the NEPA coverage for the upgrades as they are proposed.

Design, construction and operation of the SNS is planned in accordance with the following schedule:



3.0 MITIGATION ACTION PLAN MONITORING & REPORTING SYSTEM

DOE Order 0451.1A requires

> "... tracking and annually reporting progress made in implementing, and the effectiveness of, any mitigation commitment made in a record of decision."

DOE will report on the progress of mitigation measures in *the Oak Ridge Reservation Annual Site Environmental Report*. This report is prepared in accordance with DOE Order 5400.1, "General Environmental Protection Program." Information on all mitigation actions taken during each calendar year, including a description of the environmental monitoring data collected and a summary of the effectiveness of each mitigation measure, will be included in this annual report.

A manager, independent of the specific technical program, will verify mitigation results and determine if the mitigation actions achieved their intended purposes. In most cases, this will be the Director for Environmental Safety and Health for the SNS. Existing organizational and administrative controls will be used to gather information regarding the implementation and status of mitigation actions. Such controls include applicable reporting systems, inspection, and verification. The results of inspection and verification will be compiled by the anniversary of the Mitigation Action Plan. After mitigation actions are completed and verified, this information will be included in *the Oak Ridge Reservation Annual Site Environmental Report*.

4.0 MITIGATION MEASURES AND MITIGATION ACTION PLANS

This section begins with a discussion of the design features DOE will implement to avoid or minimize adverse effects on groundwater, surface water, and terrestrial wildlife from construction and operation of the SNS. It is followed by a discussion of unavoidable adverse effects and the DOE plans to mitigate these effects. This latter discussion summarizes the potential effects of SNS construction and operations on wetlands, protected species, transportation infrastructure, and research projects in the Walker Branch Watershed. In addition, it presents potential mitigation measures and outlines the specific actions DOE will take to achieve mitigation.

4.1 Design Features to Avoid or Minimize Potential Environmental Effects

In the course of the analysis of potential environmental effects from construction and operation of the SNS, there were several potential adverse effects that DOE found could be avoided by minor changes in the design of the SNS. This section summarizes these design features, and additional details can be found in the FEIS.

4.1.1 Groundwater

Operation of a linear accelerator causes the radiological activation of surrounding materials. The linear accelerator of the SNS will be covered by 26 feet (7.9 meters) of engineered earthen berm. This berm is designed to provide shielding, protecting workers and the public from radiation emitted from the linear accelerator during operation. In addition, this berm is designed to protect against the infiltration of water, thus minimizing the possibility of migration of activation products through the berm to the underlying groundwater table. The linear accelerator and accumulator ring tunnels will be covered by an impermeable clay layer, formed by compacting native soils with a high clay content. This clay layer will be covered with native soils and vegetated with native grasses. The surface will be contoured to promote runoff of precipitation. Foundation drains will be placed at the base of the tunnels to capture any water that might infiltrate the berm. Any water in the foundation drains will be stored in holding tanks for proper monitoring and disposal.

A site characterization program will be implemented on the Chestnut Ridge location selected for construction of the SNS. This program will include a subsurface characterization of the SNS site through soil borings, well installations, and other appropriate geological and geophysical techniques. The characterization data will be used to identify site-specific relationships between the surface water and groundwater, map the water table onsite, and gain a better understanding of how the groundwater characteristics of the site are related to those of the surrounding area. In addition, such data will be used to support detailed design of the shielding berm to protect groundwater quality. The characterization program will be completed before SNS construction begins on the site.

If characterization of the Chestnut Ridge site shows that further protective measures are necessary to prevent radionuclides from reaching the groundwater, the berm design would be modified to include a capillary break, a layer of crushed stone approximately 1.5 ft (0.5 m) thick placed between the clay layer and the native soils. The stronger capillary attraction of the finer-grained native soils would divert infiltrating groundwater away from the compacted clay materials. Drains at the base of the capillary break would carry diverted water to the retention basin for later discharge. To maintain its effectiveness, a porous but fine-mesh geotextile fabric membrane would be placed above and below the crushed stone to prevent the migration of soil particles into the stone interval. The capillary break will provide defense in depth by adding a second layer of protection to the impermeable clay layer. This will permit the shield materials and the tunnel structures to remain dry, thereby eliminating a mechanism for radionuclide transport.

Currently, no groundwater monitoring wells are located in the vicinity of the SNS site. Because of the potential for radionuclide contamination of groundwater during SNS operations, a groundwater monitoring program will be implemented in the vicinity of the site (refer to Section 4.1.4). This program will be designed and implemented in conjunction with the site characterization process and will involve the installation of groundwater monitoring wells at strategic locations on and in the vicinity of the Chestnut Ridge site. Baseline groundwater monitoring data will be collected prior to the beginning of construction on the SNS site. Subsequent monitoring data will be collected according to an established plan during SNS construction and throughout the operational life of the facility.

4.1.2 Surface Water

The SNS will be constructed on Chestnut Ridge in the vicinity of the headwaters of White Oak Creek. The SNS has several design features to protect this surface water resource from adverse effects.

A retention basin (approximately 2 acres or 0.81 ha) will be constructed to collect surface water runoff from the SNS site. This basin will allow sediment to settle out of the water and will control the rate of water discharge from the basin to White Oak Creek. As a result, effects on stream characteristics and flow, water quality, and aquatic resources downstream from the outfall into White Oak Creek will be minimized.

Water from the cooling towers will be directed to the retention basin. The basin will allow further reduction in the temperature of the effluent prior to its discharge into White Oak Creek. This reduction will minimize the potential effects of elevated water temperatures on the ambient temperature of the creek and temperature-sensitive aquatic resources. This will also allow the dissipation of chlorine prior to discharge into White Oak Creek. If the residence time in the retention basin is not sufficient to assure sufficiently low levels of chlorine for the protection of life in White Oak Creek, the cooling tower blowdown will be dechlorinated prior to release to the retention basin.

Water from the retention basin will not be discharged to the upper reaches of White Oak Creek. This section of the creek will be protected by routing the effluent, via pipeline, to an outfall location on White Oak Creek south of Bethel Valley Road. This strategy avoids effects on the existing baseline NPDES monitoring activities, including the ORNL Biological Monitoring and Abatement Program, and other ORNL research activities involving the headwaters of White Oak Creek.

To further protect the headwaters of White Oak Creek, a 100- to 200-ft (34- to 68-m) buffer zone of uncleared vegetation will be retained along the creek channel. This will minimize the effects of solar radiation on water temperature and protect the cool-water aquatic life (e.g., fish species such as the banded sculpin and blacknose dace) that inhabits this portion of the creek.

4.1.3 Terrestrial Wildlife

A continuously forested pathway will be retained along Chestnut Ridge to allow terrestrial wildlife that may be affected by construction of the SNS an uninterrupted, forested pathway along the ridge. This will help minimize the effects of forest compartmentalization.

4.1.4 Surface and Groundwater Monitoring

DOE will implement a monitoring program for both surface and groundwater resources to help assess the efficacy of SNS design features in avoiding adverse environmental effects. This monitoring program will begin prior to construction as part of the site characterization activities and will be integrated with existing surface and groundwater monitoring programs at ORNL. The results will be published annually in the *Oak Ridge Reservation Annual Site Environmental Report*.

4.2 Mitigation Actions

This section summarizes the anticipated adverse effects of SNS construction and operations on wetlands, protected species, transportation infrastructure, and research projects in the Walker Branch Watershed. In addition to describing potential measures for mitigating these effects, it outlines the specific actions DOE will take to achieve mitigation. The section also lists the parties responsible for each action and the completion dates for the planned actions.

4.2.1 Wetlands

Potential Impacts: Eight wetlands are located in the vicinity of the SNS site at ORNL. Improvements to Chestnut Ridge Road during construction of the SNS would require the filling of 0.23 acres (0.09 ha) in three of these wetlands. The areas that will be affected are all of wetland WOM14, the southern half of WOM15, and the southwest corner of WOM16. The laying of utility lines may encroach on a small area of these wetlands adjacent to the road. In addition, wetlands WOM16 and WONT1-1 could be affected by increased runoff and siltation during construction. Wetland WONT1-1 is also located near the potential site of the SNS retention basin. The clearing of land for this basin and the resulting creation of forest edge may change the vegetation community of WONT1-1. This change may include the introduction of exotic plant species such as privet (*Ligustrum sinens*). Wetlands BCST2-1, WOM17, WOM18, and WONT2-1 are not in areas likely to be disturbed by SNS construction. As a result, effects on these wetlands would be minimal. The potential effects of SNS construction on wetlands are described in Section 5.2.5.2 of the FEIS.

Mitigation Measures: DOE will take the actions listed in Table 4.2-1 to mitigate potential adverse effects on wetlands. The project will coordinate with the Nature Conservancy (NC) for identification and remediation plans for wetlands, and will engage in formal consultations with the U.S. Army Corps of Engineers (USACOE) and the Tennessee Department of Environment and Conservation (TDEC) concerning the potential mitigation measures. Such consultations will provide an opportunity to more fully identify, evaluate, and select mitigation measures for the affected wetlands. The implementation of mitigation measures will be completed before the initiation of any SNS-related construction that would have the potential to affect wetlands.

Table 4.2-1. Mitigation Action Plans for Wetlands

Action	Responsible Party	Completion Date
Coordinate with the NC and consult with USACOE and TDEC to more fully identify, evaluate, and select mitigation measures for effects on wetlands.	DOE-ORO	Prior to construction.
Design mitigation measures for effects on wetlands.	ORNL	Prior to construction.
Develop and document plans for mitigation monitoring.	ORNL	Prior to construction.
Implement mitigation measures for effects on wetlands.	ORNL	Within 1 year after start of construction.
Implement mitigation monitoring and reporting.	ORNL	Begin 1 year after start of construction — annually.

Subject to the results of coordination/consultations with NC, USACOR, and TDEC, DOE plans to replace the filled wetland areas with at least 0.23 acres (0.09 ha) of man-made wetlands that are as much like the original wetlands as possible, preferably within the watershed of White Oak Creek. This will involve the creation of a new wetland along the channel of a tributary to White Oak Creek or enlargement of an existing wetland (e.g., the area around the springs in wetland WOM15).

Best management practices, such as silt fences and stormwater control structures (e.g. vegetated swales), will be applied to minimize the effects of runoff and siltation on wetlands WOM16 and WONT1-1. Further, although for lesser effect, these measures will also be applied to wetlands BCST2-1, WOM17, WOM18, and WONT2-1. There will be periodic inspections by project staff and DOE to assure these controls are installed and maintained.

The distance between the SNS retention basin and wetland WONT-1 will be increased to the extent practicable. This action is designed to minimize changes in the vegetation community of the wetland as a result of land clearing for the basin.

4.2.2 Protected Species

Potential Impacts: DOE has begun informal consultation with the U.S. Fish and Wildlife Service concerning protected species (see Appendix D of the SNS EIS). None of the federally listed or proposed threatened or endangered species specified in their letter (September 26, 1997) have been found at the Chestnut Ridge site at ORNL. The SNS site and adjacent areas at ORNL were surveyed for protected species of plants and animals in the early spring of 1997. This reconnaissance survey was conducted to support preparation of the SNS EIS. At locations in the immediate vicinity of the SNS site that would not be heavily disturbed by construction or operations, pink lady's slipper (*Cypripedium acaule*) and American ginseng (*Panax quinquifolius*) were identified. The former is a Tennessee endangered species due to commercial exploitation, and the latter is a threatened species in Tennessee. Although no protected species were identified on the SNS site, about 20 percent of the 147 acres (59.5 ha) of land in Natural Area (NA) 52 overlaps the site. The original bases for the establishment of NA52 were the presence of protected species and protected species habitat. Consequently, construction and operation of the SNS on the selected site at ORNL may affect protected species that could not be identified during the 1997 survey. The potential effects of SNS construction and operations on protected species are described in Section 5.2.5.4 of the FEIS.

Mitigation Measures: The overall DOE process for mitigating effects on protected species will begin with a systematic survey of the SNS site, access roads, and utility corridors for protected species. Because definitive identifications of many protected plants can be made only when they are flowering, this survey would extend over the spring, summer, and fall seasons of 1999 to maximize the probability of identifying such plants. It will be completed before the initiation of any SNS-related construction activities that might have the potential to affect protected species. If protected species are found in areas subject to disturbance by SNS construction or operations, DOE will begin formal consultations with the U.S. Fish and Wildlife Service (USFWS) and TDEC to develop appropriate mitigation measures. For example, potential measures could include fencing habitat containing protected plant species or transplanting such species to areas of similar habitat that would not be affected by SNS construction or operations.

DOE will take the actions listed in Table 4.2-2 to achieve mitigation of any effects construction and operation of the SNS may have on protected species. Implementation of mitigation measures will be completed prior to the initiation of any SNS-related construction activities that could affect protected species.

Table 4.2-2. Mitigation Action Plans for Protected Species

Action	Responsible Party	Completion Date
Conduct a systematic, three-season (spring, summer, and fall) survey of the SNS site, access roads, and utility corridors for protected species.	ORNL	First quarter of CY 2000
If protected species would be affected by construction or operation of the SNS, consult with the USFWS and TDEC to more fully identify, evaluate, and select mitigation measures for these effects.	ORNL	First quarter of CY 2000 Before initiating the impacting construction or operation.
Design mitigation measures for effects on protected species.	ORNL	Determined during consultation but before initiating the impacting construction or operation.
Develop and document plans for mitigation monitoring.	ORNL	Determined during consultation but before initiating the impacting construction or operation.
Implement mitigation measures for effects on protected species.	ORNL	Determined during consultation but before initiating the impacting construction or operation.
Implement mitigation monitoring and reporting.	ORNL	Determined during consultation

4.2.3 Cultural Resources

Potential Impacts: No prehistoric or historic sites listed on or eligible for listing on the National Register of Historic Places (NRHP) have been identified on the SNS site at ORNL. Construction and operation of the SNS would not affect cultural resources in this area. However, the SNS design team has not established the areas where construction or improvement of utility corridors would be necessary to support the SNS, and the full route of the southwest access road to the site has not been determined. As a result, the specific effects of road and utility construction on any cultural resources that may be present in these areas could not be assessed in the FEIS.

Mitigation Measures: Considerable information is available on the cultural resources of the ORR, particularly the historic resources. The SNS design team will establish utility corridors and the right-of-way for the southwest access road to avoid known cultural resources. Prehistoric and historic sites that are considered to be potentially eligible for listing on the NRHP will also be avoided. The utility corridors and right-of-way for the southwest access road will be firmly established prior to the beginning of SNS construction.

Prior to the beginning of road improvements and utility construction in these areas, a formal survey will be conducted to identify any previously unknown prehistoric or historic cultural resources that may be present. If prehistoric or historic sites are identified during the survey, archaeological testing may be necessary to gather information pertinent to an assessment of NRHP eligibility. If data from the survey and testing indicate that construction will affect cultural resources, DOE will implement mitigation measures.

Throughout the survey, assessment, and mitigation process, DOE will continue the State Historic Preservation Officer (SHPO) consultation process initiated during preparation of the SNS EIS. The selection of appropriate mitigation measures for each site will be done in close consultation with the SHPO at the Tennessee Historical Commission. The Advisory Council on Historic Preservation and other interested parties will also be afforded an opportunity to participate in these required consultations. The potential mitigation measures would include avoidance (e.g., choosing another route or fencing a site to protect it during construction), where possible, or the implementation of data recovery operations. The data recovery operations would include detailed recording of surface features and/or archaeological excavations.

DOE will take the actions listed in Table 4.2-3 to achieve mitigation of any effects construction and operation of the SNS may have on cultural resources in utility corridors and the southwest access road right-of-way. Implementation of these measures will be completed prior to the initiation of any SNS-related construction activities that could affect cultural resources.

Table 4.2-3. Mitigation Action Plans for Cultural Resources

Action	Responsible Party	Completion Date
Establish SNS utility corridors and the southwest access road right-of-way to avoid sites listed on or potentially eligible for listing on the NRHP.	ORNL	Third quarter CY 1999 Before construction.
Conduct a Phase I cultural resources survey of the utility corridors and southwest access road right-of-way to identify prehistoric and historic sites.	ORNL	Fourth quarter CY 1999 Before construction.
If needed, perform Phase II archaeological testing of sites to gather data for assessments of NRHP eligibility .	ORNL	Fourth quarter CY 1999 Before construction.
Assess potential effects of utility and road construction on NRHP-eligible sites.	ORNL	Fourth quarter CY 1999 Before construction.
If NRHP-eligible sites would be affected, consult with the SHPO and other appropriate parties to identify and select appropriate mitigation measures.	ORO	Prior to start of construction
Design mitigation measures for effects on cultural resources.	ORNL	Determined during consultation Before construction.

Action (Continued)	**Responsible Party**	**Completion Date**
Develop and document plans for mitigation monitoring.	ORNL	Determined during consultation
Implement mitigation measures for effects on cultural resources.	ORNL	Determined during consultation
Implement mitigation monitoring and reporting.	ORNL	Determined during consultation

4.2.4 Transportation Infrastructure

Potential Impacts: Current traffic on roads in the vicinity of ORNL would increase as a result of SNS construction and operations. Traffic would increase by 7 percent during the peak year (2002) of construction on the SNS. During this year, an estimated total of 578 construction-related employees are expected to add approximately 466 daily round trips and 10 material/service truck round-trips to total ORNL site traffic of 6,771 round-trips. If the SNS is upgraded to an operating power of 4 MW, 375 operations employees and 3 service trucks per day would increase traffic by approximately 305 daily round-trips. This represents a 5 percent increase in traffic during peak SNS operations. The effects of these increases could include general traffic congestion from new vehicles traveling the roads and changes in existing vehicle flow, speed, and maneuverability. The potential effects of SNS construction and operations on transportation infrastructure are described in Section 5.2.10.1 of the FEIS.

Mitigation Measures: The effects of SNS construction and operations on traffic in the vicinity of ORNL will probably be mitigated through road improvements. DOE will determine the need for road improvements on Bethel Valley Road between the Bethel Valley Industrial Park and State Route 95, and it will select the improvements to be implemented. The department will also be responsible for any needed improvements to SNS access roads such as Chestnut Ridge Road. If improvements to other area road segments appear necessary to achieve mitigation, DOE will consult, as appropriate, with the Tennessee Department of Transportation (TDOT) and the City of Oak Ridge. These consultations will definitively determine the need for improvements, identify if ancillary impacts such as wetlands and sensitive specise are impacted, select the appropriate mitigation measures to be designed and implemented, and establish the distribution of agency responsibilities.

Apart from road improvements, another potential option for minimizing the effects of SNS construction and operations on traffic would be to vary the times at which certain employees report to and leave work. For example, craft and noncraft workers could report to work and leave work at different times, which would ease rush hour congestion on area roads.

DOE will take the actions listed in Table 4.2-4 to achieve mitigation of the effects construction and operation of the SNS may have on traffic in the vicinity of ORNL. Because the largest increase in traffic will be associated with SNS construction, implementation of mitigation measures will be completed by the beginning of such construction.

Table 4.2-4. Mitigation Action Plans for Effects on Vehicular Traffic

Action	Responsible Party	Completion Date
Determine road improvement and traffic minimization needs, and select the appropriate measures to meet these needs, consulting with the TDOT and City of Oak Ridge as necessary.	DOE-ORO	Prior to start of construction
Design mitigation measures for effects on vehicular traffic.	ORNL	Prior to peak construction period
Develop and document plans for mitigation monitoring.	ORNL	Prior to peak construction period
Implement road improvement and traffic mitigation measures.	ORNL	Prior to peak construction period
Implement mitigation monitoring and reporting.	ORNL	Prior to peak construction period

4.2.5 Research Projects in the Walker Branch Watershed

Potential Impacts: The Walker Branch Watershed is located only 0.75 miles (1.2 km) east of the SNS site at ORNL, and it is located downwind from the site with respect to the prevailing daytime winds. The National Oceanic and Atmospheric Administration/Atmospheric Turbulence and Diffusion Division (NOAA/ATDD) and the ORNL-Environmental Sciences Division (ESD) have conducted environmental monitoring and ecological research projects in the watershed since 1967. It is one of the few areas in the world characterized by long-term, intensive environmental studies. Carbon dioxide (CO_2) and water vapor emissions from SNS activities would affect current and future environmental monitoring and research projects in the Walker Branch Watershed. The potential effects of SNS construction and operations on these projects are described in Sections 5.2.8.1.1 and 5.2.8.2.1 of the FEIS.

The Temperate Deciduous Forest Continuous Monitoring Program (TDFCMP) is being conducted by NOAA/ATDD in the Walker Branch Watershed. This long-term program is monitoring the continuous exchange of CO_2, water vapor, and energy between the deciduous forest and the atmosphere. The ORNL-ESD ecological research projects in the watershed use data inputs from this monitoring project. During construction of the SNS, emissions of CO_2 from construction vehicles and other vehicles driven to and from the SNS site could affect TDFCMP monitoring of CO_2 and one long-term ORNL ecological research project in the Walker Branch Watershed. The effects of these emissions would be loss of data quality and data comparability over time.

The SNS would emit CO_2 and water vapor during operations. Although vehicles and small equipment with internal combustion engines would contribute to onsite emissions of CO_2, the highest emitters of CO_2 would be the natural gas boilers in the SNS heating system. Worst case modeling of CO_2 emissions from the boiler stacks indicates that they would adversely affect a small amount of the data collected by the TDFCMP monitoring of CO_2. The worst case modeling of CO_2 emissions from the natural gas boilers indicates that an annual average 2.77 percent of the CO_2 measurement data under the TDFCMP would be adversely affected. They would also affect one current ORNL-ESD ecological research project and two future ecological research projects.

The SNS cooling towers would emit water vapor during operations. These emissions may affect TDFCMP monitoring, two current ORNL-ESD ecological research projects, and eight future ecological research projects.

Mitigation Measures: Several potential measures are available to minimize the effects of CO_2 emissions on the TDFCMP and ORNL-ESD ecological research projects. Potential measures include:

- Establish parking lots near Bethel Valley Road during construction and operations. Electric or ultra-low-emission vehicles could then be used to transport personnel and certain materials between the lots and the SNS site. Such vehicles could also be used for onsite transportation purposes.

- Install electric heat pumps instead of natural gas boilers in the SNS heating system or transfer heat from the SNS cooling system for use in facility heating. Both alternatives would eliminate the major source of CO_2 from SNS operations.

- Use electric equipment, when practicable, instead of equipment with internal combustion engines for onsite mowing and trimming. Use low-maintenance landscaping.

- Establish an additional, complementary NOAA/ATDD meteorological monitoring tower, which contains the CO_2 monitoring equipment for the TDFCMP, at a site less susceptible to the effects from construction and operational emissions of CO_2.

Water vapor would only be emitted from the cooling towers during SNS operations. One measure that could minimize the effects of such emissions on TDFCMP monitoring and ORNL-ESD ecological research projects, which receive data inputs from the TDFCMP, is the foregoing option to establish an additional NOAA/ATDD monitoring tower.

The further identification, evaluation, selection, implementation, and monitoring of appropriate mitigation measures will depend on a cooperative technical partnership among DOE management, NOAA/ATDD, the SNS Project Office, and ORNL-ESD. The seeds of such a partnership were sown during preparation of the SNS EIS, and DOE will continue to pursue this partnership throughout the mitigation process. The centerpiece of this cooperative effort will be the establishment of a joint working committee to achieve mitigation of SNS effects on environmental monitoring and research projects in the Walker Branch Watershed. This committee will have input and oversight responsibility for each action step in the overall mitigation process for Walker Branch.

DOE will take the actions listed in Table 4.2-5 to achieve mitigation of the effects construction and operation of the SNS may have on environmental monitoring and ecological research projects in the Walker Branch Watershed. Measures to mitigate construction effects will be implemented prior to the initiation of any SNS-related construction activities that could affect monitoring and research. Similarly, measures to mitigate effects from SNS operations will be implemented prior to the commencement of such operations.

Table 4.2-5. Mitigation Action Plans for Effects on Walker Branch Watershed Research

Action	Responsible Party	Completion Date
Establish the Joint Working Committee (DOE Management, SNS Project Office, ORNL-ESD, and NOAA/ATDD) to achieve mitigation of SNS effects on environmental monitoring and research projects in the Walker Branch Watershed.	DOE	10/1/99
Identify, evaluate, and select mitigation measures for effects on environmental monitoring and research projects in the Walker Branch Watershed.	Joint Working Committee	Established by Joint Working Group
Design mitigation measures for effects on environmental monitoring and research projects in the Walker Branch Watershed.	ORNL	Established by Joint Working Group
Develop and document plans for mitigation monitoring.	ORNL	Established by Joint Working Group
Implement mitigation measures for effects on environmental monitoring and research projects in the Walker Branch Watershed	ORNL	Established by Joint Working Group
Implement mitigation monitoring and reporting.	ORNL	Established by Joint Working Group